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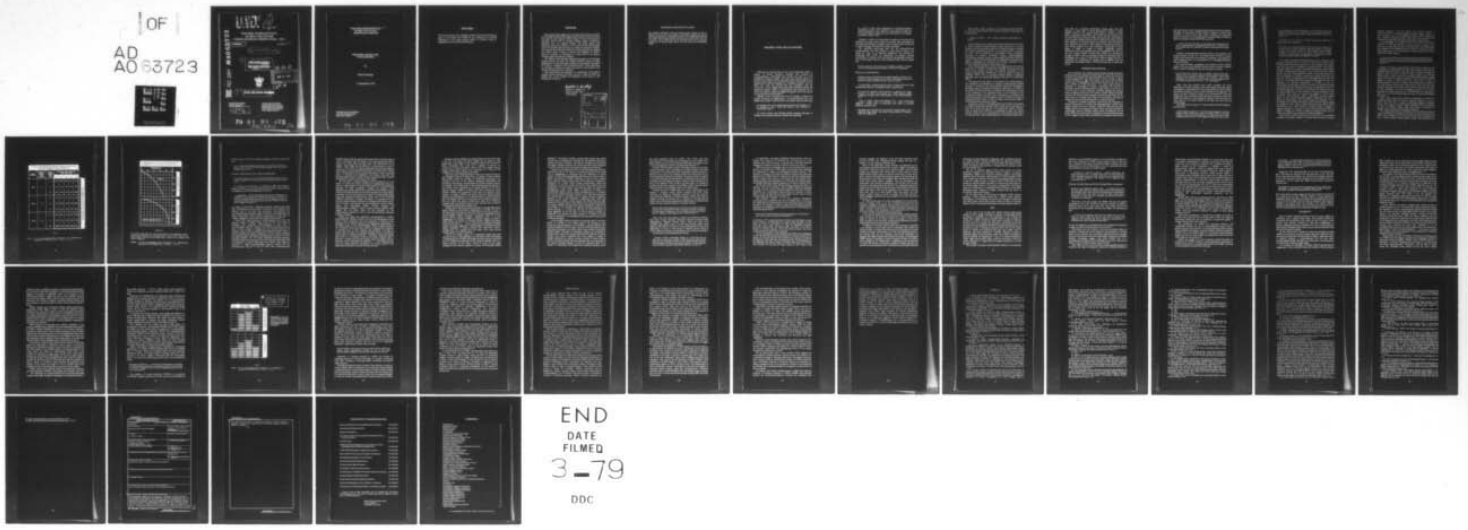

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PRECISION ATGM'S AND NATO DEFENSE

by

Robert Kennedy

11 September 1978

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FOREWORD

This memorandum suggests that the technical limitations of modern antitank guided missiles, developing countermeasures, and Soviet tactics may result in such weapons systems being a far less useful means of providing NATO with an adequate defense against conventional aggression than was originally thought. The author cautions that technology must not be asked to do too much and that NATO should expect no windfall defense savings as it equips its armies with ATGM's. He concludes that while the introduction of large quantities of ATGM's into NATO armies is likely to improve the flexibility of NATO's antiarmor defenses, an immediate or radical shift in the balance between offense and defense is unlikely.

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This memorandum was prepared as a contribution to the field of national security research and study. As such, it does not reflect the official view of the College, the Department of the Army, or the Department of Defense.

DeWITT C. SMITH, JR.
Major General, USA
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BIOGRAPHICAL SKETCH OF THE AUTHOR

DR. ROBERT KENNEDY joined the Strategic Studies Institute in 1974. A graduate of the US Air Force Academy, Dr. Kennedy completed his graduate work in political science at Georgetown University. Dr. Kennedy served on active duty briefly with the Army and then with the Air Force from 1958 to 1971 and is currently a reserve officer with the Air National Guard. Prior to his present position, he was foreign affairs officer, US Arms Control and Disarmament Agency.

PRECISION ATGM'S AND NATO DEFENSE

Following the Vietnam War and the 1973 Arab-Israeli conflict, a number of defense specialists concluded that advances in precision-guidance technologies had marked the birth of a new revolution in modern warfare. Ian Smart, then Deputy Director of Britain's Royal Institute for International Affairs, was reported to have remarked that modern technology has "consigned to history" an era in which the "tank and aircraft ruled the battlefield," that the introduction of new, highly mobile and simply operated antitank and antiaircraft missiles "marks a transformation that recalls the way in which the longbow enabled the English footsoldier of the 14th century to overcome the mounted knight."[1]

Malcolm Currie, testifying before the US Congress as Director of Defense Research and Engineering in the spring following the 1973 Middle East conflict, reinforced such conclusions when he stated that

> A remarkable series of new technological developments has brought us to the threshold of what I believe will become a true revolution in conventional warfare.[2]

Dr. Amos Jordan, then Principal Deputy Assistant Secretary of Defense for International Security Affairs, also noted that

> As a result of major recent developments in conventional weapons technologies, we may be at the threshold of a new era in the conduct of warfare comparable in some respects to earlier periods in which new technologies rendered obsolete the tactics and concepts, even strategies, governing the conduct of war. [3]

Likewise, a number of articles began to appear in the press and in professional journals which seemed to indicate that technology was effecting major changes in modern warfare, changes which would have an impact on major US and NATO security concerns.[4]

The battlefield experiences with air- and ground-delivered precision-guided munitions (PGM's) in both recent conflicts were viewed by many as an empirical confirmation that advances in technology offer NATO an opportunity to improve, perhaps substantially, its ability to deter and defend conventionally. Stanley D. Fair, former Deputy Director of the Strategic Studies Institute, argued that

> Precision weaponry will increase the warfighting capability of NATO forces, thereby enhancing their credibility as a deterrent to aggression.[5]

Moreover, he contended that

> Precision weaponry would increase the combat capability of NATO forces, contribute to the achievement of an effective direct defense option, and permit the strategy of flexible response to become a reality.[6]

Kenneth Hunt, writing during his tenure as Deputy Director of the International Institute for Strategic Studies, remarked that

> It is plain that militarily NATO would be in a relatively far stronger position if its forces were equipped with ATGMs [antitank guided munitions] and SAMs [surface-to-air missiles] on a much wider scale than now.[7]

James F. Digby, Senior Staff Member of the Rand Corporation, suggested a similar sense of enthusiasm with regard to precision weaponry when he wrote

> Something quite remarkable has been added to modern military forces: weapons in large number, each having a high probability of hitting its target with a single shot.[8]

While Digby's initial assessment of the potential impact of PGM's on European defense efforts was somewhat guarded, nevertheless, he concluded that

> . . . these new weapons . . . will, on balance, probably be advantageous to NATO.[9]

Such analyses seem to suggest that NATO no longer need be forced to choose between defense policies which either rely on nuclear escalation and the potential destruction of Western Europe or demand the enormous expenditures likely to be required if NATO is to match the heavy Soviet investment in conventional military capabilities, especially in armored formations. Rather, precision-guidance technologies, especially modern antitank guided munitions (ATGM's), appear to offer a potentially effective counterbalance to growing Soviet military capabilities by enhancing the inherent advantages of the defense, improving flexibility, and reducing cost.[10]

Some defense specialists, however, have suggested that the technical limitations of ATGM's, coupled with developing countermeasures and Soviet tactics designed to offset the apparent advantages of such weapons, indicate that ATGM's may be far less useful as a means of providing NATO with an adequate defense against conventional aggression than was immediately apparent after the 1973 Arab-Israeli War.[11]

The purpose of this paper is to contribute to an understanding of the capabilities and limitations of modern precision-guided antitank weapons, to eliminate some misconceptions which have developed in the public debate concerning the potential contribution of ATGM's to the defense of Western Europe, to underscore the complexities involved in any assessment of the probable impact of such weapons on the conventional defense of NATO, and to contribute to a defining of the probable spectrum of political-military utility of ATGM's as a means of enhancing NATO's ability to deter or defend conventionally against a Soviet/Warsaw Pact nonnuclear attack.

Arguments in favor of exploiting this new potential for the defense of Western Europe have generally relied heavily on the experiences of both the Vietnam War and the 1973 Arab-Israeli conflict. However, there is always some difficulty in attempting to apply the "lessons learned" under one set of circumstances to other places at other times. In a general sense, other things being equal, conclusions reached from a

case study of a particular phenomenon should apply with little variation to other cases of similar phenomenon. However, *"ceteris paribus"* seldom, if ever, applies. Other things are usually not equal. Hence, assumptions which have been derived from the experiences of the latter days of the Vietnam conflict and October War concerning the value of precision-guided weapons must be subjected to intense scrutiny when applied to a European theater environment. Time and distance have interceded and tend to cloud efforts to transpose the lessons of these recent conflicts into crisp conclusions concerning the likely impact of PGM's on conflict in Europe. Geographic variance, differences in the actors involved and in their capabilities, the effects of the very "lessons learned" during both conflicts on contemporary strategy, doctrine, tactics, and weapons design, the inevitable march of technology, and a host of other factors render complex the task of translating the experiences of Vietnam and the Middle East into assumptions concerning conflict in Central Europe today or in the near future.

DEFENSE OVER OFFENSE

The contention that modern precision-guided antitank munitions inherently favor the defense is founded upon the notion that the events of recent wars indicate that target acquisition is now the key to success on the battlefield. If a target can be seen, it can be hit with a modern ATGM. And as James Digby of the Rand Corporation and one of the early students of PGM's has noted, "For many targets, hitting is equivalent to destroying."[12] Hence, concealment has become an important feature of the battlefield. If a target moves, it can be seen. If it can be seen, it can be destroyed. Generally speaking, the attacker must concentrate his forces for an advance, usually through unfamiliar territory. His forces are thus exposed to detection and attack. On the other hand, it is usually much easier for the defender, operating in familiar terrain from prepared positions, to remain concealed.

Proponents of precision weaponry contend that the topography of Western Europe serves to enhance the advantage likely to accrue to the defense should war occur in Europe. Unlike the Sinai and the Golan Heights which for the most part is open country not often amenable to concealment, much of Western Europe favors concealment. On the flanks, PGM's are well suited for operations in Norway along the fjords or in its rugged country which sits astride the principal north-to-south

approach routes. Soviet forces advancing southward would be naturally channeled by the terrain. ATGM's could be employed to inflict heavy casualties on Soviet forces while NATO mobilized and dispatched troops for defense. On this point General Alexander Haig, the Supreme Allied Commander Europe (SACEUR), has noted,

> . . . anyone who visits [Norway] can only leave with the impression that this is a defensible land. It channelizes attacking forces. It lends itself to strong mobile defense by dedicated, competent, well-equipped fast-moving forces.[13]

Likewise, precision-guided munitions should prove valuable in the mountain passes of Italy or in the rough terrain of Greece or eastern Turkey. Such terrain favors the mobility, concealment, and capacity for rapid dispersion likely to be characteristic of a well-organized defense based on ATGM's.

In central Germany, topography also promises to favor antitank defense. On this point Brigadier General Edward Atkeson, currently Chief of Staff for Intelligence, US Army Europe, has written,

> West Germany has extensive tracts of densely forested terrain and a number of growing urban areas which would tend to channel enemy armor formations into roadways, firebreaks, and farmland . . . and provide defending forces with natural and man-made cover and concealment quite beyond that existing in either the Sinai or the Golan Heights.[14]

Apart from the forested areas which dominate the direct approaches to central Germany and provide choke points and natural concealment to defending forces, the urban buildup to which Atkeson has alluded promises to pose a serious problem to any aggressor. The terrain of much of Western Europe is now dominated by cities and villages that have sprawled outwards and tend to converge. Towns have spread like spokes on a wheel along the roadnets which serve them. In some cases, it is no longer possible to tell where one town ends and another begins.

Paul Braken, in his study on "Urban Sprawl and NATO Defense," has noted that

> A typical defensive position for a NATO armoured brigade on the East German border contains about eighty-five villages and has a defensive frontage of some twenty-five kilometers. The villages and forests would comprise nearly 60 per cent of the available terrain, and—because of their

> spatial distribution and the domination of roads and open avenues of approach through the sector—Warsaw Pact forces attacking tanks would be unable to bypass one village without almost immediately running into another.[15]

Likewise, the US Army has marked the special significance of "urban sprawl" by noting that

> Many areas of the world, especially Western Europe, have experienced a massive growth in built-up areas and man-made changes to the natural landscape. These changes significantly affect potential future battlefields. Avoidance of built-up areas is no longer possible. Rather, military operations in built-up areas are an integral part of combat operations and present special opportunities and challenges at all levels.[16]

In an age of precision antitank weaponry such a situation could seriously complicate efforts to execute a swift armored thrust across Central Europe. Viewed from the eyes of a Soviet planner, every village, town, and city must be considered a potential barrier, every house a potential pillbox from which concealed NATO forces could employ ATGM's to devastate attacking armor. Thus, in Western Europe, "urban sprawl" and other terrain features are likely to pose major obstacles to the free movement of military forces across Europe which may well serve not only as a strong deterrent to Soviet aggression, but also as the basis for an effective antiarmor defense should deterrence fail. As a minimum, the defensive employment of ATGM's in such an environment would appear to offer the prospect of slowing the tempo of major Warsaw Pact offensive thrusts, an accomplishment which not only might gain time for NATO to mobilize its vast resources in order to repel an aggression, but also is likely to place an additional burden on Warsaw Pact forces. As Atkeson has suggested, "Slower paced operations would certainly require considerably increased support forces to keep combat elements supplied, maintained, and fed."[17] Moreover, as the logistics "tail" grows to support the offensive "teeth," the likelihood of a whirlwind surprise attack would fade. While it might be possible on short notice to field a number of tank and motorized rifle divisions for a swift thrust into Central Europe, a buildup of supplies necessary to conduct the more sustained operations likely to result if ATGM's are effective in halting or slowing a Soviet armored attack is less likely to go undetected by Allied intelligence.

One must be careful, however, not to fall prey to an unqualified optimism concerning a defense of Western Europe based on modern

antitank munitions. First, the Soviets have already acquired a substantial arsenal of precision-guided antitank weapons which, in many instances, can be used effectively against NATO. Despite the West's defensive orientation, NATO forces will often be locally on the offensive executing armored probes and armored counterattacks.

Correspondingly, not all Warsaw Pact forces would be involved in offensive or blitzkrieg operations. Such operations are likely to be restricted to those areas chosen by the Warsaw Pact for breakthrough. The remainder of the Warsaw Pact forces would be tasked to defend a much larger portion of the front against a NATO counterattack. On this point, James Digby suggests,

> . . . even a massive Warsaw Pact offensive may involve the attacker holding defensively along 95 percent of the front, while thrusting offensively along the other 5 percent. And NATO must, in many places, go locally on the offensive.[18]

Second, the same terrain features which afford protection and concealment to defending NATO forces also provide a terrain mask for attacking Warsaw Pact forces. The hills, forests, villages, and vegetation serve to break the field of fire/line of sight necessary for defending ATGM crews to acquire and fire on attacking armored targets at ranges where ATGM's are at a distinct advantage.[19] For example, if an ATGM attacks a target at 3000 meters, the missile time of flight is approximately 15 seconds. If a gunner acquires and fires in 20 seconds at a tank moving toward him at the rate of 8 mph, the tank must remain exposed for 126 meters for the ATGM to score a hit (see table 1). The probability of a tank remaining exposed for 126 meters (provided no evasive maneuvers or countermeasures are employed) is only .35 on the North German Plain and only .64 in the Fulda Region (see table 2).

Third, while urban sprawl offers an opportunity for NATO to enmesh attacking armor in a grid of antiarmor defenses, it is by no means clear that such a strategy is politically feasible in Western Europe. In the event of conflict, NATO (especially Western Germany), for fear of collateral damage, might well decline to transform its villages, towns, and cities into strong point defenses.

In a study conducted for the Defense Advanced Research Projects Agency (DARPA) by the Rand Corporation on military operations in built-up areas (MOBA), the authors noted that such operations were not a "favored subject among military thinkers and practitioners in

TYPICAL MINIMUM SEGMENT LENGTHS (METERS) FOR SUCCESSFUL ENGAGEMENTS

RANGE (METERS)	APPROX. MISSILE FLIGHT TIME (SECONDS)	TANK SPEEDS (MILES PER HOUR)	DETECTION AND ACQUISITION TIMES (SECONDS)				
			10	20	30	40	60
1000	5	4	27	45	63	81	117
		8	54	90	126	162	234
		13	90	150	210	270	390
2000	10	4	36	54	72	90	126
		8	72	108	144	180	252
		13	120	180	240	300	420
3000	15	4	45	63	81	99	135
		8	90	126	162	198	270
		13	150	210	270	330	450

SEGMENT LENGTH IN METERS

Table 1

SOURCE: US Army, Field Manual 100-5 (Washington, DC: Headquarters, Department of the Army, July 1, 1976), p. 13-14.

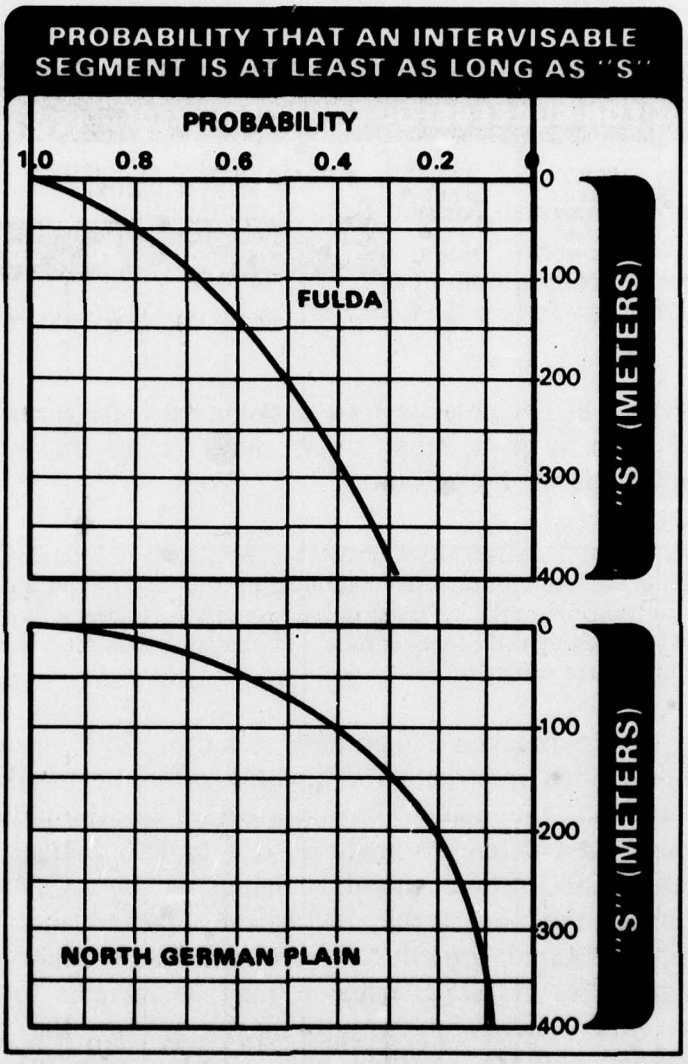

Table 2*

*The table shows that the hills and forests in the American sector provide more exposure for attacking armor than the flat land of the North German Plain where attacking armor is more often screened from view by vegation.

SOURCE: US Army, Field Manual 100-5 (Washington, DC: Headquarters, Department of the Army, July 1, 1976), p. 13-15.

NATO Europe."[20] A Dutch civilian strategist is quoted as having said that

> In our country little thought is being given to city warfare. The idea is so abhorent that it does not allow for closer scrutiny. Our cities will be declared "open cities."[21]

Likewise a West German Army officer contended that

> We prepare to fight in front of the cities and between the cities. If we had to fight an enemy force in the Ruhr area, the war would already be lost for us.[22]

In wartime, in the absence of a decision to fight from village to village and town to town, urban sprawl may become, as Paul Bracken has suggested, a decided disadvantage to the West.

> . . . urban sprawl . . . offers the Warsaw Pact the chance of reducing its own vulnerability and simultaneously complicating the task of the defence. A massive conventional attack, based in part on city-hugging tactics but not necessarily excluding traditional combat in open areas, could be termed the NATO "nightmare scenario."[23]

According to the Bracken "nightmare scenario," built-up areas with their well-developed road networks "would offer the invading forces mobility and at the same time protection, both physical and psychological (since defenders might be reluctant to damage their own cities), while NATO forces would be hampered by a heavy flow of refugees clogging the roads as they fled before a Pact advance."[24]

Fourth, the rapid growth of countermeasures may limit the defensive utility of ATGM's. While it may, in fact, be too early to determine how successful countermeasures to the host of precision-guided antitank weapons now entering inventories will be, there is little evidence to suggest that the current generation of precision weapons will be immune from determined efforts to jam or confuse tracking and guidance equipment. In fact, several techniques for interfering with or deceiving such equipment have been or are now becoming available. For the current generation precision weapons, relatively simple countermeasures such as smoke and camouflage could be employed to obscure advancing forces. Smoke alone might be sufficient to defeat manually-guided antitank missiles like the French-German MILAN or the US TOW. Since manually-guided

ATGM's require that the operator have visual contact with the target in order to accurately place the missile on the target, smoke generated to obscure the target would seriously reduce the effectiveness of such missiles. Lasers might also be utilized as countermeasure in order to "blind" a wide variety of systems employing electro-optical guidance, while flares, as was demonstrated during the Yom Kippur War, could be used to defeat infrared sensors. Fog aerosols appear to offer a promising means of defeating laser designation and homing, while radio link jamming might be used to disrupt systems requiring data links to permit the operator to guide the munitions to the targets.

The US Army is already working on the development of a new family of smoke and aerosol materials and dissemination devices to serve as countermeasures to threats which employ the electromagnetic spectrum for target acquisition, tracking, and guidance. Such developments include rapid smoke screens for tanks and other armored vehicles, and advanced smoke rounds and warheads for existing artillery projectiles, mortars, and rockets to be used for screening large combat areas and countering electro-optical threats such as the SAGGER ATGM.[25] Moreover, in Sweden, according to a spokesman for the National Defense Research Institute, an artificial smoke which is cheap, easy to produce, and nontoxic has been developed to protect military targets from laser-guided missiles, infrared weapons, and television-guided missiles.[26] There is ample evidence available which suggests that the Soviet Union has also embarked on such countermeasure programs in order to limit the effectiveness of Western precision munitions.

Perhaps the single most significant countermeasure to modern precision-guided weapons, however, has been the development of new forms of armor protection, the most prominent of which has been developed by the Military Vehicles and Engineering Establishment at Chobham, Surrey, in the United Kingdom. While no design details of the "Chobham" armor have been released, it is apparently a composite of materials such as steel, ceramics, and aluminum. According to reports, this new armor can withstand multiple attacks by virtually all known types of antitank projectiles. "Chobham" armor has already been fitted to an improved version of the British Chieftain tank.[27] Moreover, a similar type of armor plating, which, according to former Secretary of the Army Martin R. Hoffman, ". . . could withstand a hit from any missile deployed anywhere in the world today,"[28] has apparently been fitted to the new US tank, the XM-1.

Perhaps at least as significant as the development of the armor itself is the fact that these new armor designs do not appear to add appreciably to the weight of the vehicles to which they are fitted.[29] Hence, presumably they could also be applied to improve the protection of armored personnel carriers and other lightly armored vehicles which have become more vulnerable as a result of the proliferation of modern antiarmor munitions.

Such new armor designs are likely to force an increase in the size of the warheads necessary to defeat them. A change to larger warheads will probably reduce the mobility of ATGM units and result in an increase in the cost of the weapons themselves. Nevertheless, this potentially revolutionary countermeasure to modern precision weapons is not likely to be viewed with as much enthusiasm among members of the Warsaw Treaty Organization as among members of the North Atlantic Alliance. While it is likely that future variants of Soviet armored vehicles will incorporate some form of composite armor resistant to modern ATGM's, the Soviet Union has already invested heavily in the development of its armored forces. In Central Europe alone the Warsaw Pact has over 20 more armor divisions equivalents than has NATO and almost 10,000 more tanks, all of which are equipped with now obsolete forms of armor and can only be replaced at exceptional political and economic cost.

Finally, Soviet tactics may offset a number of the advantages which appear inherent in the defensive employment of ATGM's. In view of the heavy Soviet investment in armored vehicles, the new generations of precision-guided antitank munitions have sparked considerable interest among Russian defense specialists. Apparently there is no real disagreement over whether ATGM's are effective. Rather, according to Phillip Karber, the Director of Strategic Studies at BDM Corporation, debate has focused on "... how to overcome the challenge of antitank weapons and retain a high rate of advance against a strengthened NATO defense capability."[30] Karber contends that while neat "policy" packages have not emerged from this debate, three major tactical options appear to be under discussion.

First is the nuclear option. It is apparently argued that since armored forces are still considered to be the prime means of exploiting a breakthrough and ATGM technologies threaten a tactical revolution and the potential abandonment of the armored offensive, there is a strong incentive for the Soviet Union to return to her earlier dependence upon nuclear weapons as a means of overcoming antitank

defenses.[31] According to Karber, several Soviet writers have argued recently that, in anticipation of nuclear fire, the defender will have to disperse his forces. Moreover, with the use of highly accurate nuclear fire against defensive positions, the infantry does not have to dismount from APC's and the attack can proceed at a high rate of advance.[32]

Comments concerning the utility of such an option must, however, be guarded. First of all, while it is true that the NATO forces would have to disaggregate if confronted with the likelihood of nuclear conflict and that dispersed defending formations may not be as able to deliver the density of ATGM's necessary to slow or halt a massive Soviet armored attack, Soviet forces would also have to disperse in preparation for a likely NATO nuclear counterattack. Under such conditions it is far from certain that Soviet forces would be the net beneficiaries. To the contrary, one American author has argued that well-dispersed NATO forces might, if deployed in depth in a checkerboard defense pattern, embed attacking armor in a defensive grid, stop its forward movement, weaken it, and create the opportunity for counterattack.[33] Secondly, such an option, ipso facto, suggests a lowering of the nuclear threshold—a significant effect since most Western defense analysts usually assume that PGM's raise the likely threshold of nuclear activity. Nevertheless, such a potential lowering of the nuclear threshold through Soviet nuclear preemption, while not an event likely to be welcomed by Western European statesmen and defense planners, in a sense may well serve as a useful deterrent to Soviet aggression in the first place, as Soviet planners consider the likelihood of an American strategic response to a conflict in Europe which was initiated by an unambiguous full-scale Soviet nuclear attack on Western positions.

A second option which has become an important part of the Soviet debate on ATGM's is the artillery option. The absence of crew protection, traceable signatures, the inability to operate ATGM's from locations displaced from the crews, the lack of fire-and-forget systems, and certain constraints on mobility render many currently operational ATGM's highly vulnerable to suppressive artillery fire. According to Phillip Karber, many Soviet authors argue that in the absence of nuclear weapons only massive suppressive fire from artillery is capable of reliably destroying an enemy's antitank defense.[34] Soviet artillery officers writing in military journals emphasize that the suppression of the enemy's antitank defenses "is the most important task of the artillery."[35] Historically, the Russians have considered artillery one of

the most important arms of conflict. Two world wars have demonstrated to the Russians that the firepower of the attacker has a direct influence on the success of the breakthrough, and artillery is one of the most significant means of providing such firepower.[36]

However, like the nuclear option, the artillery option is not entirely without drawbacks. First, attempting to coordinate artillery with tanks and infantry is a complex task. Such coordination is likely to result in a slowing of the pace of the offensive which may offer NATO time to more adequately mobilize for the defense. Second, as artillery is massed to overcome obdurate antitank defenses, an additional strain is likely to be placed upon the logistic structure, forcing a further restraint on the pace of the offensive. Third, artillery has little effect on standoff or air-delivered antiarmor weapons. And, finally, NATO can guard against losses to artillery by providing protection for ATGM crews.

Perhaps the most troubling tactic now under consideration is the surprise or maneuver option. Karber contends that Soviet armor advocates are calling for preemptive maneuver as the best means of overcoming the challenge of antitank weapons. Rather than slow the offensive through the massive use of artillery or through infantry sweeps, they would prefer attacking the defense before it mobilizes and deploys its dense antitank defenses. According to Karber,

> There are then several indications that in the event of conflict with NATO the Red Army would prefer to launch a surprise attack without needing to rely upon massive mobilization of the rear echelon divisions in the Soviet Union or filling out understrength forces of the Warsaw Pact.[37]

This is the worst case scenario to which such observers as Senator Sam Nunn, General Johannes Steinhoff, Lieutenant General James Hollingsworth, Brigadier General Robert Close and others have addressed their alarms. Such an attack using in-place theater forces might provide NATO with little or no prior warning. Given the current deployment of forces or lack thereof in Western Europe, failure to receive adequate warning of an impending attack could be catastrophic.

On this point General Steinhoff has written,

> . . . Western frontline, conventional defenses on a day-to-day basis are weak, and too much time is needed to bring troops of the various North Atlantic Treaty Organization nations to their forward defensive positions. The Netherlands, as a worst case example, would have to load troops and tanks on trains to bring them within driving distances to the front.[38]

In comparison, according to Brigadier General Robert Close, the Warsaw Pact could put 39 divisions into the front line in a first offensive wave within 48 hours. A second wave of 60 Soviet divisions augmented by major Czech forces could be in action in 6 days.[39]

What has become increasingly clear in recent months is that, in the absence of warning time, NATO might be prevented from mobilizing and deploying its modern precision-guided antitank defenses. This situation is, perhaps, most acute in northern Germany where peacetime deployments of NATO forces are relatively few and their collapse might permit a rapid Soviet march to the North Sea and Channel Ports, cutting the lines of communication to NATO forces in central Germany and perhaps effecting a general collapse of the Western defense effort.

On the other hand, many Western defense analysts argue that a no warning, "bolt out of the blue" attack is highly unlikely. Reinforcing this point of view, General Alexander Haig has stated that the West, benefiting from technological improvements, has acquired a greater ability to pick up signs that an attack might be near, such as troop concentrations and movements of forces.[40]

The problem, however, is not that sufficient information concerning troop movements will not be available prior to an attack, but rather that the interpretation of such movements may be clouded by events. For example, it could be argued that the Israelis had ample warning of the impending Arab attack in the Fall of 1973. However, as Chaim Herzog has noted,

> It was as if the assumption that the Arab armies could not or would not go to war [had] caused a complete mental blackout.[41]

In February 1973, large quantities of Soviet arms had begun to reach Egypt; however, the Egyptians had received large quantities of arms from the Soviet Union before. In May the Egyptians purchased powerful, turbine-driven fire pumps which were later to be used to breach the eastern ramparts of the Suez Canal; however, they were acquired under the guise of fire equipment.

As war approached, Soviet personnel and USSR naval contingents at Port Said and Alexandria departed Egypt, but this was viewed by the Israelis as a hopeful sign that the Soviets did not approve of whatever the Egyptians may have been contemplating. Even in mid-September as the Egyptians and Syrians began to assemble their forces, few Israelis were worried. For the past 10 years, except in 1967 when it was

otherwise engaged, the Egyptian Army had held maneuvers every autumn and the slow, methodicial Syrian buildup was seen as a response to recent Israeli air raids into Syria.

Then, in late September, Israeli attention was distracted as two Arab gunmen identifying themselves as merely "Eagles of the Palestine Revolution" held up a train at the Austrian border, took five Jews hostage, and demanded that Austria close a transit center in Vienna called Schonau Castle, which was used by Soviet Jews on their way to Israel. Austria's Chancellor Bruno Kreisky agreed to the demand and let the gunmen go free. Israel was outraged, public meetings were held, the Israeli press carried banner headlines, and the government was preoccupied with political communiques. And all this as the October elections in Israel approached. On October 5th, as Egyptians made final preparations for the attack and Syrian armor maneuvered in full view of Israeli observation posts in what appeared to be defensive positions (hull down, dug in to resist assault rather than mount one, with medium artillery placed to cover not Israeli, but Syrian territory), Israeli intelligence reported that the possibility of war was "the lowest of the low."[42]

At 1400 the next day, the world was awakened to one of the great lessons of modern times. In an age of sophisticated electronics and expanded intelligence capabilities, warning time was found to be not simply a function of the amount of relevant information gathered, but rather a function of the perceptions of that information as it is clouded by events and filtered through human imperfections.

So the surprise scenario is one with which Western defense planners must contend not only because it is simply one of many options which might be selected by the Soviet Union, but because it is one tactic which promises to have the effect of significantly offsetting the Western technological lead in precision-guided weaponry.

In addition to the three options which have surfaced in unclassified Soviet writings, a fourth option must be considered. That option, the chemical option, is usually overlooked in almost all analyses of conflict scenarios in Europe. Nevertheless, one of the most impressive lessons of the October War was the realization that Soviet equipment was designed with highly sophisticated chemical, biological, and radiological (CBR) defenses. According to General Creighton Abrams, US officials were surprised by the sophistication, completeness, and extensiveness of Soviet CBR devices on equipment supplied to Egypt and Syria and captured by Israel during that war. Captured devices included personnel

protection and decontamination equipment and air filtration systems for combat vehicles. Abrams testified that the captured equipment indicated that the United States is well behind the Soviets in such devices and agreed with members of Congress that the situation could be a very serious one.[43]

The use of chemicals against NATO forces, which are neither adequately equipped nor effectively trained to fight in a chemical environment, might be an attractive alternative should a bold Soviet offensive thrust encounter stiff resistance by NATO antiarmor PGM teams. Rather than dismount infantry from armored personnel carriers or wait for artillery support to counter NATO ATGM teams and risk slowing an offensive heavily dependent on surprise and rapid maneuver, the Soviets might choose to use toxins or incapacitants. Such agents might be very effective in neutralizing NATO's antiarmor teams while permitting Soviet infantry to remain mounted and the attack to proceed at a high rate of advance.

On the other hand, in the absence of effective NATO chemical defenses, a Soviet chemical attack risks a NATO nuclear response. Nevertheless, it would appear that the use of chemicals in conjunction with other Soviet tactics offers options which are likely to seriously degrade NATO's technological advantage in precision-guided weaponry.

COST

At the close of the October War, defense analysts began asking whether in fact it might be possible to provide a conventional defense in Europe at acceptable cost. The experiences of the Vietnam and Middle East conflicts seemed to indicate that it would no longer be necessary to match in kind the huge Soviet investment in armored forces in order to be assured of a successful conventional defense. The introduction of the SAGGER ATGM by the North Vietnamese and the successes of trials of helicopter-mounted TOW's held by the United States in Vietnam had indicated that high value targets could be destroyed with great efficiency.[44] Likewise, Egyptian successes in defending against counterattacking Israeli armor units were hailed by many as marking the beginning of a new era of defense thinking for NATO. High value armored targets could now be destroyed with near perfect efficiency by a single round of antitank munitions at a cost of less than $5,000.

The concept of modern precision-guided weapons as cost-effective

additions to the battlefield, however, is not based solely on figures of unit costs. Proponents of PGM's contend that not only are unit costs low in relation to the targets which they are likely to destroy, but more importantly, life cycle costs are likely to be low. Addressing this issue Kenneth Hunt has written that PGM's should

> . . . contribute to manpower savings by . . . reducing maintenance and logistic demands, such as modular replacement by factory-made parts rather than repair by men in the field. Life cycle costs, of which manpower is an important component, will usually be more significant than procurement costs.[45]

Likewise, Goeffrey Kemp and Robert Pfaltzgraff have commented,

> Perhaps the most significant military effects . . . [of PGMs] relate to the ease with which many new weapons can be operated and maintained on the battlefield. These trends have obvious advantages for the United States and its allies because they reduce the need for highly skilled military technicians at a time when the sociological and economic problems of recruitment are increasing.[46]

Moreover, it has been argued that PGM's will ease the logistics requirements. Not only will fewer rounds be required to destroy a particular target, but in some cases even those rounds need not be transported to the battlefield. On this point Digby has hypothesized that

> . . . a fraction of the munitions used need not be hauled all the way to the FEBA in systems where the units up front serve as spotters and designators; the munitions they call in might be ground-launched or air-launched from tens of kilometers farther back.[47]

In sum, the argument is made that fewer men, hauling fewer munitions of greater accuracy, promise reduced cost for NATO.

The debate over cost, however, is far from concluded. While it is difficult to estimate the costs in manpower and equipment of a defense based on the extensive use of precision weaponry until the concepts, doctrines, and force postures surrounding their use have been specified, evidence increasingly suggests that while ATGM's may be a fundamental requirement of the battlefield of the future, they are not likely to result in reduced defense costs for NATO.

First, while the unit cost of a modern precision-guided round is low relative to the target it is designed to destroy (for example $4,000 for a

TOW missile versus $500,000-$1,000,000 for a main battle tank), such a comparison is misleading. As a minimum, system costs rather than per round unit costs should be considered. For example, according to figures released by the Department of Defense, it would cost approximately $130,000 to field a complete TOW system including launcher, night sight, and 10 missiles.[48] Moreover, while progress is being made on developing advanced ATGM systems capable of overcoming current limitations such as operations at night and in poor weather, these systems will be significantly more expensive than those currently being deployed. It has been reported that the Hellfire (a helicopter-launched "fire and forget" antitank missile) will be at least four times more expensive than the TOW.[49] Hence, one can anticipate that as more advanced PGM's come into the inventories of the NATO nations, not only will unit costs expressed in costs per missile round be greater, but system costs expressed in terms of the required missiles, launchers, and vision/target acquisition equipment will rise significantly.

Second, there will be an increasing need for protection for PGM crews. In any future conventional conflict in Europe, it would seem likely that ground-launched ATGM's and their crews will be subjected to intense artillery barrages and suppressive air-delivered weapons. As an example of the potential magnitude of Soviet suppressive capability, NATO can expect to be confronted with as many as 70-100 Soviet artillery tubes per kilometer deployed in support of their leading maneuver forces.[50]

Under such circumstances, it has become necessary for NATO to provide some protection for its ATGM crews so they can withstand suppression attacks and then be prepared to concentrate rapidly to counter a Warsaw Pact armor offensive.

The requirement to provide crew protection, however, will substantially increase the cost of precision-guided systems. Even a minimum system such as the M-113 armored personnel carrier currently being modified to incorporate currently available, relatively inexpensive ATGM's such as the TOW is likely to cost several hundred thousand dollars once the cost of the vehicle, its modifications, and costs for the TOW system are accounted for.[51]

Finally, the prospect of a war in Europe in which both sides are equipped with ATGM's is likely to require significant expenditures to increase the quantities of prepositioned stocks. James Digby, reflecting on the experiences of recent wars, observed,

> Even though . . . the total weight of munitions to do the job may decrease over the entire time of the conflict, the rate of use–in terms of fractions of stocks consumed–is likely to go up. The material destroyed *per day of fighting* is likely to be an order to magnitude greater than we have been thinking about for nonnuclear war.[52]

During the 1973 Arab-Israeli War, by the end of the seventeenth day 1700 tanks and 500 guns had been destroyed on the Arab side alone–losses which according to one observer were roughly equivalent to the total armament in these categories of the US Seventh Army in Germany.[53] On the Israeli side, Major General Chaim Herzog has observed that,

> The intensity of the war took the quartermaster staffs by surprise. The expenditure of ammunition was inordinately high, the losses of aircraft were serious, the figures of tanks destroyed were alarming.[54]

Such observations strongly suggest that the next conflict in Europe will be a "come as you are war." Attrition is likely to exceed replacement capabilities. Hence, the earlier and perhaps the most significant portions of the war will be fought with the stocks of equipment and munitions available in the theater before the outbreak of the conflict. Without sufficient prepositioned stocks, a war in Europe may well be lost before NATO's reserve potential can be effectively brought into play.

FLEXIBILITY

One of NATO's principal problems is how to cope, rapidly and effectively, with a massive armor attack. The traditional method of countering the effectiveness of the tank has been to oppose it with another tank. However, ATGM's not only serve synergistically to enhance traditional antiarmor techniques, but also, in many instances, their inherent flexibility makes them a more attractive alternative than the tank for antiarmor defense.

On the former point it should be noted that tank guns are more reliable and accurate at very short ranges. They have a high rate of fire, and each round fired has a minimum time of flight to target and, hence, is relatively immune to countermeasures. On the other hand, precision-guided missiles, although more vulnerable to countermeasures, are much more accurate at longer ranges.

It is, however, the flexibility of modern ATGM's that has fired the imagination of those concerned with armor defense in Western Europe.

Many ATGM's are easy to operate and many are lightweight and easily transported. They can be hand-carried or transported in small trucks or helicopters. Others can be mounted on fixed or rotary winged aircraft or launched from rear areas to be guided during their final phase of flight by a single individual who with a small laser target designator would become a significant threat to attacking armor.[55]

The mobility of modern antiarmor PGM's had been first brought to the attention of many defense analysts during the latter stages of the Vietnam War when TOW ATGM's mounted on Bell UH-1B helicopters successfully destroyed a variety of armored targets. Moreover, the trials in West Germany in 1972 seemed to underscore the magnitude of the potential advantage helicopter-borne ATGM's might have over the tank in modern combat. In joint trials conducted by US, German, and Canadian forces on 1600 square kilometers of Central European countryside, COBRA helicopters armed with TOW ATGM's were pitted against attacking armor. The results of the trial indicated that helicopters so equipped employing hovering fire at stand-off ranges would be extremely effective in destroying attacking armor. Exchange ratios greater than 10 to 1 in favor of the helicopters were experienced during the trials.[56]

It was, however, the ease of operation and combat successes of ATGM's during the 1973 Arab-Israeli War which prominently marked the flexibility of modern precision-guided antitank munitions. During the early hours of that war, lightweight ATGM's proved to be of great value to the Egyptians. Egyptian infantry, carrying man-portable ATGM's crossed the canal, scaled the eastern ramparts, and were positioned to repel early Israeli armored counterattacks, while the bulk of the Egyptian forces continued to cross the canal. Emphasizing the ease of operation of modern ATGM's, one author noted that the effects attained were produced by what was "supposed to be an 'unsophisticated' army, and by what probably were, for the most part, green troops." In fact, the author continued, ". . . any troops, no matter how primitive, can become proficient in the employment of precision weapons with little training."[57]

The mobility and ease of operation which has been demonstrated by ATGM's in the past suggest a number of promising opportunities for improving NATO's antiarmor defenses. First, ATGM's mounted on helicopters or aircraft, operating from safe zones or rear area havens and using "nap-of-the-earth" techniques, could be used to swiftly transit the battlefield under almost all but the worst weather

conditions. Such a capability promises to combine speed and firepower and to provide NATO with an ability to concentrate antitank defenses rapidly at the points of significant stress. In the absence of such air-delivered ATGM's, it might take days to move sufficient armored forces and their logistic support train to meet the same threat. Second, helicopters can be used to transport air-mobile antitank infantry and their weapons to remote locations in order to bolster ground antiarmor forces.

Finally, because ease of operation reduces training requirements, conceivably NATO might be able to create and maintain special antiarmor units. Such units could be a part of the regular armed forces or could be maintained in a cadre status to be fleshed out by reserves and rapidly transported to the battlefield in time of conflict.[58] Or they could be held in reserve as ground or air mobile forces to be rapidly transported by truck or helicopter to the battlefield as weaknesses in the defense are identified.

While advances in technology have offered a flexibility on the modern battlefield which appears to promise a significant improvement in NATO's antitank defenses, the issue is by no means conclusive. Experiences under actual combat conditions during the recent conflicts indicate that the helicopter may be more vulnerable than results of the trials in West Germany demonstrated. In the Middle East, both sides used helicopter-borne commando raids during which, it was reported, almost 50 percent of the helicopters were destroyed in the air.[59]

Furthermore, while the light weight of many modern ATGM's may permit the rapid airlift of antiarmor teams in order to concentrate defenses, the intratheater mobility of such teams will be constrained by the added weight of the vehicles needed to provide protection to the crews. Hence, the means of transportating ATGM crews would probably be restricted to larger cargo aircraft which would require runways for on-loading and off-loading. As a result, the rapid transport of antiarmor teams to the immediate battle area would no longer be possible. On the other hand, if no attempt were made to provide crews with a vehicle for protection while transiting the battlefield, local mobility in the battle area might be lost as ATGM teams found themselves forced to seek positions protected from Soviet artillery.

Finally, weather may seriously reduce the employment flexibility of current generation ATGM's. James Digby has accurately noted that "... the technology for accurate guidance that is most fully developed requires transmission through the atmosphere in the visible spectrum or

near visible spectrum. . . ."[60] As a result, many current generation ATGM's are ineffective in adverse weather (clouds, fog, or haze) or at night.

During the 1973 Middle East war, while good surface visibility and minimal cloud coverage presented no significant barrier to the use of ATGM's during the daytime, the effective use of precision-guided antitank weapons was somewhat limited during nondaylight hours. On the other hand, weather will be a significant factor in any European conflict. Major General J. M. Allen has noted, "During the winter months the area has either darkness or bad weather a total of 86 percent of the time."[61]

In northern and central Germany, cloud ceilings and visibility are below 3000 feet and 5 miles more than 50 percent of the time from October through March. Moreover, fall, winter and early spring are usually characterized by frequent fog which, oftentimes, severely restricts visibility and does not clear until midday (see table 3).

Poor visibility and low ceiling not only would reduce the effectiveness of ground- or air-launched ATGM's such as TOW, Dragon, or Hellfire, but also would restrict the operation of precision-guided cannon-launched guided projectiles (CGLP) and terminally-guided submissiles (TGSM's). Both projectiles require a period of time after penetrating cloud cover to acquire the target and make those final course alterations necessary to achieve high hit probabilities. Low ceilings and limited visibilities would reduce the time incoming projectiles have to make such corrections, thus severely hampering the successful employment of such precision-guided weapons.

Night is also likely to impose greater constraints on a successful employment of ATGM's in Western Europe than it did on the Middle East or Vietnam. Much of the highly prized and most seriously threatened terrain of Central Europe is located above 47° north latitude—a line which roughly corresponds with the US-Canadian border. As a result, the winter days are very short. As one author has noted,

> Experience in [PGM] use . . . in Vietnam and the Sinai may be misleading for Central Europe, particularly if an uncooperative enemy chose to attack in November, confident of 15 to 16 hours of darkness every day for the next three months.[62]

The inability of current generation ATGM's to be operated successfully at night could prove to be even a more serious limitation as

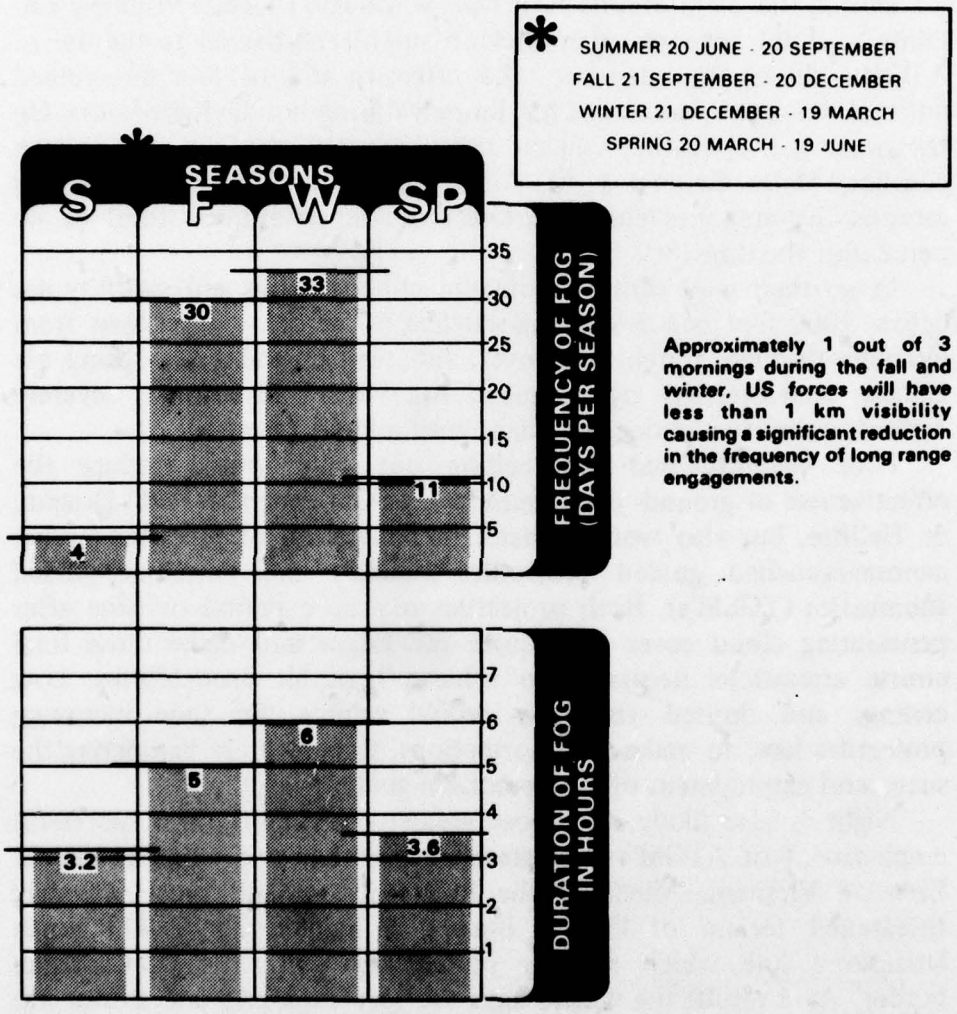

Table 3

SOURCE: US Army, Field Manual 100-5 (Washington, DC: Headquarters, Department of the Army, July 1, 1976), p. 13-11.

the Soviets continue to emphasize surprise and continuity of operations through shock power and around-the-clock operations. On this, Colonel Sidonenko has written, "The striving to attain surprise and continuity in the offensive to a great depth . . . has caused an expansion in the scales and increase in the proportion of offensive actions at night."[63]

The October War provided some evidence of this increased Soviet emphasis on night operations as Arab forces, using Soviet tactics and night vision devices with which many Soviet tanks are equipped, conducted extensive operations at night. On the Golan Heights, Syrian forces had been ordered to insure that the momentum of the battle was maintained during the hours of darkness. Detailed arrangements had been made to insure effective command and control on a 24-hour basis. In the Sinai, the potential significance of nighttime operations was highlighted early in the war when two-thirds of all the losses in men and vehicles sustained by one Israeli brigade occurred during the first evening's operations.[64]

However, despite the growing Soviet emphasis on all-weather and night operations, the host of Soviet countermeasures now under development or likely to be under consideration for development, and the glaring limitations of current generation ATGM's to respond effectively under adverse weather or nighttime conditions, advances in sensor secure data link and other technologies may soon make it possible to locate, track and attack enemy forces under some of the most adverse circumstances. General William C. Westmoreland, speaking about such advances, predicted that the idea of an "automated battlefield" could become a reality within a decade.

> On the battlefield of the future, enemy forces will be located, tracked, and targeted almost instantaneously through the use of data links, computer-assisted intelligence evaluation, and automated fire control.[65]

Experience in Vietnam appeared to validate the concept of employing sensor and data-link technology as a means of achieving "real time" intelligence concerning enemy movements and general target locations.

Knowing the general location of enemy forces, however, is only one of the variables, albeit an important one, in the chain of events leading to target destruction, as was clearly evident in Vietnam. Specific targets must be pinpointed, weapons systems allocated, and then targets must be tracked and destroyed. In recent years a host of programs designed to close the current technological gap between general force location

and destruction of specific targets have been initiated.

One of the US Army's principal initiatives which might serve to overcome battlefield limitations imposed by darkness, poor weather, and/or simple but relatively effective countermeasures such as smoke or fog is the Remotely Monitored Battlefield Sensor System (REMBASS) and another is the Stand-Off Target Acquisition System (SOTAS). REMBASS consists of a family of sensors responding to a variety of stimuli, e.g., magnetic, seismic, and acoustic, with its associated data transmission and "read-out" equipment. REMBASS, in its various configurations, should provide commanders with all-weather surveillance, early warning alert, and a target acquisition capability to complement other manned and unmanned surveillance systems.[66] SOTAS will utilize helicopters equipped with moving target indicator (MTI) radar to locate tanks, vehicles, and artillery with great precision and relay this information in real time to missile, rocket, and artillery command posts.[67]

Such initiatives coupled with technological advances in radar, acoustic, laser, and thermal imaging systems promise to significantly enhance NATO's night/adverse weather ground target acquisition and attack capabilities. One drawback to such systems, however, is cost; another may be maintenance. James Digby, speaking about longwave infrared systems, suggests that while such systems will be in widespread use by 1980 and will be useful at night and in smoke, dust, and haze, they will be fairly expensive and may be significantly harder to maintain in the field.[68] Likewise, Richard Burt contends that while PGM's now under development "will be able to operate in adverse conditions, the costs of these systems are significantly greater than those of currently deployed equipment."[69]

A third drawback may be weight. Although night vision devices can and, in some cases, are being fitted for use with such lightweight antitank systems as TOW, Dragon, Milan and HOT, the additional weight of systems capable of "seeing" through smoke, fog, and aerosols is likely to limit the flexibility of such systems for use by infantry antitank forces. Hence, the Western advantage in sophisticated and highly accurate ground mobile antitank systems is likely to remain somewhat offset by a continuing vulnerability of such systems to simple and relatively inexpensive Soviet countermeasures such as smoke and aerosols.

CONCLUSIONS

The initial euphoria with which the age of the modern precision-guided antitank weapon was greeted appears to be unsupported by an analysis of the evidence now at hand. For those that were forecasting a "revolution" in modern warfare—a revolution which would provide a flexible and effective deterrent at reduced cost—it would appear that this new wave of advanced technology represents, rather than a revolution, an evolution in the age-old process of action and reaction in arms developments. This is not to suggest, however, that no advantages are likely to accrue to NATO as it seeks to exploit its superiority in technology, nor to deny that steps might be taken which will significantly enhance the utility of these new generations of weapons within given bounds. Rather, it is to caution that technology must not be asked to do too much and to suggest that the spectrum of utility of precision weaponry with respect to NATO defense is much narrower than analyses immediately following the Vietnam and Yom Kippur Wars had indicated.

NATO should expect no immediate or radical shift in the balance between offense and defense. The mobility and firepower of the tank will continue to remain important factors on the battlefield. The numbers, capabilities, and employment tactics of Soviet armored forces will continue to have a substantial effect on the outcome of the battle. A surprise attack, currently one of NATO's major concerns, which caught large segments of the NATO force structure in their peacetime locations far from potential areas of conflict, conceivably might overrun much of Western Germany before modern ATGM's could be employed in support of the defense. Likewise, the use of chemicals would find NATO forces, whether equipped or not with such precision munitions, unprepared for combat in such an environment.

On the other hand, even under more standard conventional conflict scenarios, NATO might not find itself the unmitigated beneficiary of weapons designed to strengthen the defense. While modern precision guidance technologies favor concealment and dispersal and, ergo, appear to favor NATO forces operating in defense of familiar terrain, NATO is likely to wage a "dynamic defense." Such a defense would include a variety of "tactically" offensive operations such as amphibious assaults, armored probes, and armored counterattacks. Correspondingly, not all Warsaw Pact forces would be involved in offensive or blitzkrieg operations. Rather, offensive operations are

likely to be restricted to those areas selected for breakthrough. The remainder of the Warsaw Pact forces would be tasked to defend a much larger part of the front against NATO counterattacks. On the tactical counteroffensive, NATO might find itself at a disadvantage as the Soviet/Warsaw Pact forces employ ATGM's in defense.

Precision ATGM's, however, may well complement NATO forces defending in areas of obvious Soviet offensive activity by providing NATO with a potentially useful means of slowing and attriting Warsaw Pact armored forces. This may prove to be especially true in mountainous areas on the flanks, in the rolling hill country of central Germany, and possibly on the North German Plain if employed in villages and towns as part of an interlocking defensive grid.

Such uses, however, are subject to some constraints. While NATO countries are developing a number of advanced precision munitions, many current generation ATGM's are ineffective in adverse weather (clouds, fog, haze, etc.), at night, or under similar conditions resulting from active countermeasures such as the use of smoke and aerosols. Should the Soviet Union initiate hostilities during the winter months when days are short and often characterized by adverse weather conditions, NATO forces which had come to rely on current generation ATGM's might find themselves in a relatively disadvantageous position.

Likewise, the construction of an interlocking defense network based on urban areas on the North German Plain would require a decision by West Germany to transform its villages, towns, and cities into strong points. At the present time there is little evidence to suggest that such an action is politically feasible.

Nevertheless, the flexibility of NATO antiarmor defenses is likely to be improved by the addition of modern, lightweight, precision-guided munitions. Such weapons mounted on airborne platforms or delivered by artillery units promise to permit NATO to concentrate its antiarmor capabilities at the point of potential breakthrough more rapidly than ever in the past. Helicopters using terrain masking, nap-of-the-earth techniques, and tactical aircraft employing standoff ATGM's could contribute to NATO's ability to slow, attrite, and hopefully defeat a conventional assault by Soviet armored forces. The effectiveness of their contributions, however, will largely be a function of the ability to overcome adverse weather, night and countermeasures limitations mentioned above and Soviet/Warsaw Pact air defenses, which currently rely on a host of precision-guided/terminally homing SAM's and radar directed guns.

The potential impact of the massive use of artillery fires, however, is likely to more narrowly circumscribe the spectrum of utility for lightweight, hand-held, infantry ATGM's. The intratheater mobility of these antiarmor teams using such weapons will be considerably reduced by the requirement for some form of vehicle for crew protection. While such a vehicle would provide mobility and protection for ATGM teams once in the immediate vicinity of the battle area, the teams could not be easily airlifted to points of maximum concern.

Nevertheless, the light weight and ease of training and operation of a number of modern precision weapons suggest that it may now be possible for NATO to create and maintain special land-mobile, antiarmor units. Such units could be part of the regular armed forces to be maintained in a cadre status and fleshed out by reserves for rapid transit to the battlefield in time of conflict, or they could be part of a reserve force held for use as weaknesses develop in the defense.

Finally, NATO can expect no windfall defense savings as it equips its armies with precision-guided antitank weapons. While the dollar cost, for example, of a modern ATGM may be relatively low compared to that of a high value armor or aircraft target, system costs (including such items as the launcher, required optics, and guidance packages) are likely to be high. This will especially be true as ATGM systems are modified to provide crew protection and all-weather and night capabilities.

Moreover, if the equipment attrition rates evident during the 1973 Arab-Israeli conflict are indicative of the attrition rates which are likely in a European conflict in which both sides are heavily equipped with modern ATGM's, adequate preparedness for conflict is likely to dictate an increased requirement for prepositioned stocks of war reserve materials at increased cost to NATO.

On the other hand, there is some evidence which suggests that technologically advanced precision weapons systems will contribute to a manpower savings by reducing maintenance and logistics demands. Such a savings would be welcomed by a number of NATO nations that have traditionally preferred to substitute advances in technology for military manpower and, in some instances, continue to be confronted by multiple and competing demands for manpower in other sectors of their economies.

On balance, the evidence available seems to suggest that while the inclusion of precision weaponry in NATO arsenals will somewhat improve the conventional balance in Europe, the confidence that

NATO had in its ability to deter and defend against a Soviet conventional aggression, in an era when the United States possessed an unquestioned superiority in strategic and tactical nuclear weapons, is not likely to be restored by modern precision weaponry. Rather, it is probable that NATO will continue to find it necessary to rely on a strategy of "flexible response" which does not exclude the use of nuclear weapons to deter a Soviet conventional attack, and will continue to remain convinced that such a Soviet attack would result in a nuclear exchange on the continent of Europe with all the resultant devastation that might entail. Hence, in the absence of an immediate or imminent threat which might stimulate the defense expenditures designed to produce the quantity and quality of conventional forces likely to be perceived by the East as well as the West as an adequate deterrent to a nonnuclear aggression, NATO will be obliged by a continuing buildup of Soviet/Warsaw Pact conventional forces to continue its search for a means of defending Europe short of the use of nuclear weapons.

ENDNOTES

1. See "A Battlefield Post-Mortem," *Time,* November 12, 1973, p. 57.

2. US Congress, House, Committee on Appropriations, *Department of Defense Appropriations for 1975, Hearings,* before a Subcommittee of the Committee on Appropriations, House of Representatives, 93rd Congress, 2nd Session, April 29, 1974, Part 4, p. 450.

3. Amos A. Jordan, "Introduction: New Technologies and US Defense: Planning for Non-Nuclear Conflict," in *The Other Arms Race,* ed. by Geoffrey Kemp, Robert L. Pfaltzgraff, Jr., and Uri Ra'anan, Lexington, Massachusetts: D. C. Heath and Company, 1975, p. XI.

4. For example see, John W. Finney, "Guided Bombs Expected to Revolutionize Warfare," *The New York Times,* March 18, 1974, p. 1; Gwynne Dyer, "Is Blitzkrieg as Passe as the Trenches?" *The Baltimore Sun,* October 5, 1975, p. KI; Edward B. Atkeson, "Is the Soviet Army Obsolete?," *Army,* May 1974, pp. 10-16; John T. Burke, "The Changing Nature of Modern Warfare," *Army,* March 1974, pp. 12-16; G. H. Turley, "Time of Change in Modern Warfare," *The Marine Corps Gazette,* December 1974, pp. 16-20; and John Marriott, "New Weapons for Defense in Europe," *NATO's Fifteen Nations,* December 1973/January 1974, pp. 55-62.

5. Stanley D. Fair, *Precision Weaponry in the Defense of Europe,* Military Issues Research Memorandum, Carlisle Barracks, Pennsylvania: Strategic Studies Institute, December 15, 1974, p. 8.

6. *Ibid.*, p. 3.

7. Kenneth Hunt, "New Technology and the European Theater," in *The Other Arms Race,* p. 120.

8. James F. Digby, *Precision-Guided Munitions: Capabilities and Consequences,* Santa Monica, California: The Rand Corporation, June 1974, p. 1.

9. *Ibid.*, p. 2.

10. For a representative sample of the unclassified literature on precision-guided munitions, see Edward B. Atkeson, *Precision-Guided Munitions: Implications for Detente,* Military Issues Research Memorandum, Carlisle Barracks, Pennsylvania: Strategic Studies Institute, September 16, 1975; Richard Burt, "New Weapons Technologies and European Security," *Orbis,* Summer 1975, pp. 514-532; James Digby, *The Technology of Precision Guidance--Changing Weapon Priorities, New Risks, New Opportunities,* Santa Monica, California: The Rand Corporation, November 1975; Stanley D. Fair, *Precision Weaponry in the Defense of Europe;* G. Kemp, R. L. Pfaltzgaff, Jr., and U. Ra'anan, *The Other Arms Race;* John Marriott, "The Anti-Tank Problem," *NATO's Fifteen Nations,* April/May 1972, pp. 72-85; John Morse, "New Weapons Technologies: Implications for NATO," *Orbis,* Summer 1975, pp. 497-513; Michael L. Nacht, "Technology and Strategy," *National Defense,* November/December 1976, pp. 199-202.

11. As early as 1974 it was becoming clear that some US Department of Defense officials recognized a number of factors which were likely to affect the performance of precision-guided munitions when such weapons were applied to a European battlefield. See US Congress, House, *Committee on Appropriations, Department of Defense Appropriations for 1975, Hearings,* before a

Subcommittee of the Committee on Appropriations, House of Representatives, 93rd Congress, 2nd Session, April 29, 1974, Part 4, pp. 465-466. Since then a number of commentaries have marked the potential limitations of PGM's. For example, see Major General J. M. Allen, *A Conventional Strategy for the Central Front in NATO: Part I, An American View,* Report of a Seminar held at the Royal United Services Institute for Defence Studies on October 23, 1974 and March 26, 1975, London: The Royal United Services Institute for Defence Studies, n.d.; James Digby, *Precision-Guided Weapons,* Santa Monica, California: The Rand Corporation, March 1975; Richard M. Ogorkiewicz, "The Future of the Battle Tank" in *The Other Arms Race;* and Uri Ra'anan, "The New Technologies and the Middle East: Lessons of the Yom Kippur War and Anticipated Developments," in *Ibid.*

12. Digby, *Precision-Guided Weapons,* p. 7.

13. G. M. Bailley-Cowell, "Apprehension Without Fear . . . An Interview with General Alexander M. Haig, Jr.," *NATO's Fifteen Nations,* February/March 1976, p. 24.

14. Atkeson, "Is the Soviet Army Obsolete?," *Army,* May 1974, p. 12.

15. Paul Bracken, "Urban Sprawl and NATO Defence," *Survival,* November/December, 1976, p. 255.

16. US Army, *Field Manual 100-5,* Washington, DC: Headquarters, Department of the Army, July 1, 1976, p. 14-15.

17. Atkeson, "Is the Soviet Army Obsolete?," p. 15.

18. Digby, *Precision-Guided Weapons,* p. 23. Also see Richard Burt, "New Weapons Technologies and European Security," *Orbis,* Summer 1975, p. 523.

19. Tank guns are more reliable and accurate at very short ranges. ATGM's are much more accurate at longer ranges. Beyond 1000 meters, ATGM's have hit probabilities of between 75 percent and 85 percent, while guns fall off rapidly approaching zero at 3000 meters. At 4000 meters such weapons systems as the HOT, the Swingfire, and the TOW are essentially invulnerable to the fire of attacking tanks. See Atkeson, "Is the Soviet Army Obsolete?," p. 12. Also see *Field Manual 100-5,* pp. 2-8.

20. Lilita I. Dzirkals, Konrad Kellen, and Horst Mendershausen, *Military Operations in Built-up Areas: Essays on Some Past, Present, and Future Aspects,* Santa Monica, California: The Rand Corporation, June 1976, p. 53.

21. *Ibid.,* p. 54.

22. *Ibid.*

23. Bracken, "Urban Sprawl and NATO Defence," p. 259.

24. *Ibid.,* p. 255. It should, however, be noted that fighting in cities is neither a preferred tactic nor strategy of the Soviet armed forces. Nevertheless, the Soviet Union has given an increasing degree of emphasis to MOBA. See John C. Scharfen and Michael J. Deane, *Soviet Tactical Doctrine for Urban Warfare,* Washington, DC: Stanford Research Institute Strategic Studies Center, December 1975, p. 4; and US Defense Intelligence Agency, *Soviet Military Operations in Built-up Areas,* (DDI-1100-155-77), July 1977.

25. See US Congress, House, Committee on Armed Services, *Department of Defense Appropriations for Fiscal Year 1978, Hearings on Military Posture and HR 5068* before the Committee on Armed Services, 95th Congress, 1st Session, Part 3, p. 123. Also see Frank Bender, "CB Defense," *National Defense,* November/December 1975, p. 173.

26. "Sweden Reveals New 'Fog' to Shield Military Targets," *The Washington Post*, October 27, 1976, p. 9.

27. See "Improved Chieftain for Iran," *International Defense Review*, August 1976, pp. 640-642.

28. George C. Wilson, "Chrysler to Build Army Tank; Cost Could Total $4.9 Billion," *The Washington Post*, November 13, 1976, p. A2.

29. See "Improved Chieftain for Iran," p. 641.

30. Phillip A. Karber, "The Soviet Anti-Tank Debate," *Survival*, May/June 1976, p. 109. Also see James F. Kuhlman, *Influence of Anti-Tank Technology on Soviet Offensive Tactics*, Garmisch, Germany: US Army Institute for Advanced Russian and East European Studies, April 1977, p. 5.

31. *Ibid.*

32. *Ibid.*

33. Steven Canby, "The Alliance and Europe: Part IV Military Doctrine and Technology," *Adelphi Papers No. 109*, Winter 1974/1975, p. 27.

34. Karber, "The Soviet Anti-Tank Debate," p. 110.

35. See Kuhlman, *Influence of Anti-Tank Technology*, p. 11.

36. See A. A. Sidorenko, *The Offensive (A Soviet View)*, translated and published under the auspices of the US Air Force, Washington, DC: US Government Printing Office, 1970, pp. 11-19.

37. Karber, "The Soviet Anti-Tank Debate," pp. 110-111. Also See Kuhlman, *Influence of Anti-Tank Technology*, p. 11.

38. Johannes Steinhoff, *Where is NATO Heading*, quoted in "Europe Again Debates NATO Strength," *The Baltimore Sun*, April 18, 1976, p. 1.

39. See Robert Evans and Robert Novak, "NATO Fears of Soviet Superiority," *The Washington Post*, December 31, 1976, p. 13.

40. "Haig Calls NATO Drills Response to Again in Warsaw Pact Abilities," *The New York Times*, September 26, 1976, p. 10. More recently, General Haig indicated in an interview with the Armed Forces Journal that NATO can expect 8 days to 2 weeks warning of a surprise Soviet attack. See Benjamin F. Schemmer, "Haig Now Says NATO Can Expect 8-14 Days Warning, Not 48 Hours," *Armed Forces Journal*, October 1977, pp. 16-17.

41. Major General Chaim Herzog, *The War of Atonement*, Boston: Little, Brown and Company, 1975, p. 278.

42. *Ibid.*, p. 283. For a more detailed account of the events preceding the outbreak of hostilities, see *The Yom Kippur War*, Garden City, New Jersey: Doubleday and Company, Inc., 1974, pp. 59-118, upon which I have relied for much of this section.

43. US Congress, House, Committee on Appropriations *Statement of Chief, US Army, General Creighton Abrams before a Subcommittee of the Committee on Appropriations*, 93rd Congress, 2nd Session, March 5, 1974, pp. 648-649. Also see "Washington Report," *International Defense Review*, April 1974, p. 140.

44. During the 41-day test the Army was informally reported to have destroyed 44 tanks. Of these, 26 were destroyed by the TOW. TOW also accounted for six trucks, four APC's, a POL (Petroleum-Oil-Lubricants) dump, an ammunition dump, a bridge, and a bunker. See "Army's Tank Aces," *Armed Forces Journal*, July 1972, pp. 15-16.

45. Kenneth Hunt, "New Technologies and the European Theater," in *The Other Arms Race*, p. 110.

46. Geoffrey Kemp and Robert L. Pfaltzgraff, Jr., "New Technologies and the Emerging Geo-Strategic Environment," in *The Other Arms Race,* p. 139.

47. James Digby, *Precision Weapons: Lowering the Risks with Aimed Shots and Aimed Tactics,* Santa Monica, California: The Rand Corporation, September 1975, p. 14.

48. According to Defense Department testimony before Congress, in Fiscal Year 1977, 5,720 TOW missiles will cost $23.9 million dollars, 826 TOW launchers $34.7 million and 236 night sights $10.8 million. By those figures an individual TOW missile will cost approximately $4200, a launcher $42,000 and a night sight $46,000. See US Congress, Senate, Committee on Armed Services, *Fiscal Year 1977 Authorizations for Military Procurement Research and Development and Active Duty, Selected Reserve and Civilian Personnel, Hearings,* before the Committee on Armed Services, Senate, 94th Congress, 2nd Session, p. 2804.

49. See Burt, "New Weapons Technologies," p. 526.

50. See US Army, *Field Manual 100-5,* pp. 2-13.

51. According to Defense Department testimony the modification of each M-113 vehicle alone (not including weapon systems cost) will cost approximately $100,000. See US Congress, Senate, Committee on Armed Services, *Fiscal Year 1978 Authorization for Military Procurement, Research and Development and Active Duty, Selected Reserve and Civilian Personnel Strengths, Hearings,* before the Committee on Armed Services, 95th Congress, 1st Session, Part 5, p. 3929.

52. Digby, "Precision Weapons: Lowering the Risks," p. 29. Also see Colonel John T. Burke, "The Changing Nature of Modern Warfare," *Army,* March 1974, pp. 13-14.

53. Robert D. Heinl, Jr., "War With Russia in Europe Would Find the US Sorely Outnumbered," *Sea Power,* August 1976, p. 34.

54. Herzog, *The War of Atonement,* p. 227.

55. Advances in terminal homing have resulted in the development of a host of weapons which can be employed from the relative safety of the rear in order to support antiarmor defenses on the battlefield. The Army has recently developed a cannon-launched guided projectile (CLGP) which can be launched from a standard artillery tube and engage individual stationary or moving targets. CLGP relies on a forward observer to designate the target with a laser illuminator. Once the target has been designated the incoming CLGP round is capable of adjusting its course in order to impact directly on the target. Also under development are terminally guided submissiles (TGSM's) which can be launched from the LANCE missile system. Once in the target area TGSM's will be able to acquire and attack individual targets. Advances in terminal guidance also promise to permit the employment of remotely piloted vehicles and cruise missiles in order to support antiarmor operations from launch positions far to the rear of the battle area. See Frank P. Ragano, "Smart Projectiles for Sharpshooting Artillery," *National Defense,* September/ October 1975, p. 120; Phil Stanford, "The Automated Battlefield," *The New York Times Magazine,* February 23, 1975, pp. 37-39; "Funds for Advanced Lance Missile Sought by Army," *Aviation Week and Space Technology,* February 24, 1975, pp. 20-21; "The Electronic Arsenal," *Time,* March 3, 1975, pp. 58-61; and Henry Simmons, "PGM's: The Pentagon's Nonnuclear Step-children," *Astronautics and Aeronautics,* May 1976, p. 10.

56. In these trials Soviet doctrine was used as the basis of aggressor tactics.

Moreover, tanks, air defense weapons, and the helicopters were all equipped with the latest direct fire simulators (lasers) that provided a real-time "kill" capability to the various gunners. See Captain B. A. Muelaner, "The Search for the Best Antitank Defense," *Military Review,* October 1974, p. 62.

57. John T. Burke, "Precision Weaponry: The Changing Nature of Modern Warfare," p. 14.

58. For a further discussion of this concept see Robert Kennedy, "NATO Defense Posture in an Environment of Strategic Parity and Precision Weaponry," in *Strategies, Alliances, and Military Power: Changing Roles,* Leyden: The Netherlands: A. W. Sijthoff, 1977, pp. 308-309.

59. See Lawrence Whetten and Michael Johnson, "Military Lessons of the Yom Kippur War," *The World Today,* March 1974, p. 109.

60. James Digby, *Precision Weapons: Lowering the Risks with Aimed Shots and Aimed Tactics,* p.. 15. Also see Digby, *Precision-Guided Weapons,* pp. 27-30. While such a statement more accurately characterizes current generation antitank guided munitions, the capabilities of SAM's and air-to-air intercept missiles which rely on infrared homing rather than on radar are seriously degraded under adverse weather conditions.

61. Major General J. M. Allen, "An American View," *A Conventional Strategy for the Central Front in NATO,* London: Royal United Services Institute, n.d., p. 5.

62. Henry Simmons, "PGM's: The Pentagon's Nonnuclear Step-Children," p. 11.

63. Sidorenko, *The Offensive,* p. 34. Also see V. YE. Savkin, *The Basic Principles of Operational Art and Tactics,* translated and published under the auspices of the US Air Force, Washington, DC: US Government Printing Office, 1972, pp. 175-176. Lieutenant General Howard H. Cooksey, Deputy Chief of Staff for Research, Development, and Acquisition, US Army, in testimony before Congress has noted that "Over 40% of Warsaw Pact exercises are conducted at night." He further notes that "The War in the Middle East saw large tank battles fought in pitch darkness. . . ." and that "the Soviet soldier has traditionally, and with justification, prided himself on his night fighting capability." See US Congress, House, Committee on Armed Services, *Department of Defense Appropriations for Fiscal Year 1978, Hearings on Military Posture and H. R. 5068,* before the Committee on Armed Services, 95th Congress, 1st Session, Part 2, p. 123.

64. Herzog, *The War of Atonement,* p. 77. Also see *The Yom Kippur War,* p. 197.

65. "The US Army of the '70's as Westmoreland Portrays It," *US News and World Report,* December 15, 1969, p. 13.

66. See US Congress, House, Committee on Armed Services, *Department of Defense Authorization for Appropriations for Fiscal Year 1977, Hearings on Military Posture and H. R. 11500,* before the Committee on Armed Services, 94th Congress, 2nd Session, Part 5, p. 973.

67. See Simmons, "PGM's: The Pentagon's Nonnuclear Step-Children," p. 12. According to Simmons, the Army will incorporate lifting surfaces in the engineering version of CLGP in order to expand the lateral footprint of the projectile after it penetrates low cloud cover over the target area. Also see *Hearings,* supra 66, p. 972.

68. Digby, *Precision Weapons: Lowering the Risks*, pp. 15-16.
69. Burt, "New Weapons Technology and European Security," p. 521.

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This memorandum suggests that the technical limitations of modern antitank guided missiles, developing countermeasures, and Soviet tactics may result in such weapons systems being a far less useful means of providing NATO with an adequate defense against conventional aggression than was originally thought. The author cautions that technology must not be asked to do too much and that NATO should expect no windfall defense savings as it equips its armies with ATGM's. He concludes that while the introduction of large quantities of ATGM's

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into NATO armies is likely to improve the flexibility of NATO's antiarmor defenses, an immediate or radical shift in the balance between offense and defense is unlikely.

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